## Remarks

The examiner is thanked for the comprehensive office action. The examiner's objections concerning formalities have been cured by a proposed drawing amendment and amendments to the description. The attached submission of drawings shows formal drawings with the reference characters originally submitted in the application as filed in red. With this drawing amendment it will become apparent that the drive gear is indicated as (3) and the nut that sandwiches the gear is (3a). The reference character (11a) has been entered to designate the integral sleeve. In addition, the annular groove (19) has been entered on Figure 6.

With these proposed amendments to the drawings it is believed that the formalities requirements are satisfied. In addition, several changes to the description have been entered on pages 4 and 5. On page 5 passage 16a refers to the corresponding passage now identified on figure 1 in red.

The claim objections have been satisfied by complying with the requirements of the examiner. Claim 1 has been amended to emphasize the fact that the two bearings are mechanically connected so that they are constrained to rotate in unison. This is vitally important for bearing arrangements where power is taken from one end of the turbine shaft. The radial loads become substantial and it is imperative that the bearing most adjacent the gear continues to rotate. Without the interconnection to the bearing at the other end the bearing will stop and cease to be able to carry significant loads.



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In contrast, the reference to Thoren used to reject Claims 1-10 does not have bearings mechanically interconnected so that they rotate in unison. Thoren shows a standard axial spacer assembly that merely abuts to separate floating sleeve bearings. In this sense the reference to Thoren shows a standard turbocharger bearing arrangement where all the elements are free to rotate independent of one another. If the construction of Thoren was incorporated in applicant's claimed combination, the bearing closest to the drive gear would, in fact, be free to slow down and cease to rotate. Furthermore, it is not believed to be obvious to modify Thoren to meet the elements of Claim 1 because Thoren is concerned with a standard turbocharger assembly of a compressor and turbine wheel where there are not the severe reaction forces provided by a power turbine assembly. Accordingly, it is believed that Claim 1 and the claims which depend from Claim 1, are patentably distinct over the reference to Thoren and this rejection should be withdrawn.

Claims 1 through 10 were also rejected under 35USC102 as being anticipated by McInereney, Aguilar, or Okano. It should be pointed out that all of these references, while having a single piece bearing assembly, are constrained from rotating as specifically defined in applicant's Claim 1. In each of these references there is a pin or other mechanism restraining the bearings from rotation. This is a key element in allowing a film of oil to be maintained which resists the substantial reaction force. In view of this, it is believed that the rejection under 35USC102 based on these patents is inappropriate and should be withdrawn.



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The dependent claims 2 through 10 are patentably distinct over the references cited by the examiner for the same reasons as discussed in connection with Claim 1. In addition, they provide further limitations which depart even further from the prior art of record.

The remaining references have been reviewed and found not to show or teach applicant's inventive concepts.

In view of the amendments to this case, reconsideration and allowance is respectfully requested.

Respectfully submitted,

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**ATTACHMENT TO AMENDMENT**

**Serial No 09/977,804**

**In the Description:**

Replace pages 4 and 5 with the following:

Figure 2 is a perspective view of a one-part bearing incorporated in the turbocharger of Figure 1;

Figure 3 is an axial section through the bearing of Figure 2;

Figure 4 is a section on the line 4-4 of Figure 3;

Figure 5 is section on the line 5-5 of Figure 3; and

Figure 6 is a section showing one possible modification of the bearing of Figure 2.

## Detailed Description of the Preferred Embodiments

Referring to Figure 1, the illustrated turbocharger comprises a shaft 1 which supports at one end a turbine 2 and supports at the other end a drive gear 3. The shaft 1 is supported in a one piece tubular bearing 4 which is supported within a housing 5. The housing 5 is secured to a body 6 which defines a volute 7 through which exhaust gases delivered from an internal combustion engine pass to apply torque to the turbine 2. A heat shield 8 protects the bearing assembly from the hot gases which drive the turbine 2.

One end of the bearing 4 abuts a shoulder 9 defined by the shaft whereas the other end of the bearing 4 abuts a flange 10 which forms part of a thrust bearing which maintains the axial



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position of both the bearing 4 and the shaft 1. Flange 10 is part of an integral sleeve [11] 11a telescoped over an integral extension 1a of shaft 1. A second flange 10a is also telescoped over extension 1a, as is the gear 3. A nut 3a sandwiches gear 3 and flanges 10, 10a to capture, with appropriate axial clearance, a thrust bearing plate 4a which limits axial excursions of the shaft 1 and turbine 2. The thrust bearing plate is supplied with pressurized oil from main oil drilling 5a which receives suitable pressurized oil through an inlet 5b. Internal passage 4b allows pressurized oil from oil drilling 5a to provide a film between thrust bearing plate 4a and adjacent flanges 10 and 10a. The structure of the bearing 4 is shown in greater detail in Figures 2 to 5.

Referring to Figures 2 to 5, the bearing 4 defines a first bearing having an inner bearing surface 11 and an outer bearing surface 12 and a second bearing having an inner bearing surface 13 and an outer bearing surface 14. There is a clearance between the outer bearing surfaces 12, 14 and the housing 5. The surfaces 11, 12, 13 and 14 are defined at the ends of a tubular body having a central section 15 the inner and outer diameters of which are more and less than the diameters of the inner bearing surfaces 11, 13 and the outer bearing surfaces 12, 14, respectively. Passageway 16a [connect] connects oil drilling 5a with oil passageways 16 which extend between the inner and outer bearing surfaces. Pressurized oil from oil drilling 5a provides a film of oil between bearing surfaces 12, 14 and the housing 5 and between bearing surfaces 11, 13 and shaft 1. Oil drainage apertures 17 are provided in the central section 15 to ensure that oil can drain freely from the inner bearing surfaces. Axial ends 18 of the tubular bearing structure have the same outer

diameters as the outer bearing surfaces 12, 14 and greater internal diameters than the inner bearing surfaces 11, 13.

Given that the bearing 4 is formed in one piece, the bearings defined at opposite ends thereof must rotate at the same speed. Thus the rotational speed of the bearing surfaces supporting the end of the shaft adjacent the gear 3 must be the same as the rotational speed of the bearing surfaces supporting the end of the shaft adjacent the turbine 2. Thus high loads at the end of the shaft adjacent the gear 3 are prevented from slowing down and thereby reducing the load carrying capacity of the adjacent bearing surfaces.

In the illustrated example the bearing 4 is made from a single component. The central section 15 of this single component has an internal diameter greater than that of the turbocharger shaft and an external diameter less than that of the adjacent housing so as to avoid hydrodynamic drag resisting rotation of the shaft. This may not, however, be necessary in all embodiments of the invention. Rather, the proportions of the central section 15 of the bearing may be varied in order to give the correct hydrodroynamic force balance on the bearing. For example, it may not be necessary to provide a recess along the inner diameter in order to maximize the bearing speed. Thus, in alternative embodiments of the invention the inner diameter of the central section 15 may be smaller or larger than that illustrated and for instance may be equal to the diameter of the surfaces 11 and 13. Similarly, the outer diameter of the central section 15 may be smaller or larger than illustrated and may for instance be equal to the diameter of the surfaces 12 and 14.



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**In the Claims:**

Claim 1 (amended) A power turbine comprising a drive shaft supporting at one end a turbine arranged in use to be driven by exhaust gases from an internal combustion engine and supporting at the other end a drive connection which in use is coupled to a load demand of the internal combustion engine, wherein the shaft is supported in a housing by a first floating bearing adjacent to the turbine and a second floating bearing adjacent the drive coupling, the first and second bearings each defining an inner bearing surface relative to which the shaft rotates and an outer bearing surface which rotates relative to the housing, and the first and second bearings are mechanically coupled together such that [they] said first and second bearings are constrained to rotate relative to the housing at the same speed.

Claim 2 (amended) [Apparatus] The power turbine according to claim 1, wherein the first and second bearings are formed from a single tubular body through which the shaft extends.

Claim 3 (amended) [Apparatus] The power turbine according to claim 1, wherein the first and second bearings are separate components interconnected by a tubular body through which the shaft extends.

Claim 4 (amended) [Apparatus] The power turbine according to claim 1, wherein the tubular body defines radial apertures to provide oil drainage passage ways.

Claim 5 (amended) [Apparatus] The power turbine according to claim 4, wherein said housing has passageways formed therein for



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connecting a supply of pressurized lubricant to said first and second bearings.

Claim 6 (amended) [Apparatus] The power turbine according to claim 1, wherein the first and second bearings define axially-facing end surfaces which bear against retaining shoulders, the radial thickness of the end surfaces being less than or equal to the radial spacing between the inner and outer bearing surfaces.

Claim 7 (amended) [Apparatus] The power turbine according to claim 6, wherein said drive shaft has a shoulder against which one of said axially-facing end surfaces is positioned, said [apparatus] power turbine further comprising means for forming a thrust bearing adjacent the other of said axially-facing end surfaces, whereby the axial excursions of said shaft are restrained.

Claim 8 (amended) [Apparatus] The power turbine according to claim 7, wherein said housing has passageways formed therein for connecting a supply of pressurized lubricant to said thrust bearing means.

Claim 9 (amended)[Apparatus] The power turbine according to claim 8, wherein said housing has passageways formed therein for connecting a supply of pressurized lubricant to said first and second bearings.

Claim 10 (amended) [Apparatus] The power turbine according to claim 9, wherein said housing has a common passageway for connecting a supply of pressurized lubricant to said thrust bearing means and to said first and second bearings.